We have a container that contains 33.7 g of CO2 (g). The partial pressure of CO2 is 2.57 atm and the volume of the container is 28.5 L. What is the average square speed (in m / s) of the CO2 molecules in this container?

Solution:

The average square speed ($<v^2>$) is equal to $\frac{3RT}{M}$, where R is the ideal gas constant, 8.314 J/(mol·K), T is the temperature of gas and M is molar mass of gas [1]. According ideal gas law, *pV = nRT*, the temperature of gas is equal to $\frac{pV}{nR}$, or $\frac{pVM}{mR}$, where p is partial pressure (2.57 atm = 2.57 atm * 101325 Pa/atm = 260405.25 Pa), V is volume of container (28.5 L = $28.5*10^{-3}$ m^3), m is mass (33.7 g = 0.0337 kg), n is a number of moles of gas [1]. Then, $< v^2 >= \frac{3pV}{m} = \frac{3\times260405.25\times28.5\times10^{-3}}{0.0337} =$ $660672{,}07\ m^2/s^2$, or 813 m/s.

Answer: 813 m/s.

References:

1. Thermodynamics, From Concepts to Applications (2nd Edition), A. Shavit, C. Gutfinger, CRC Press (Taylor and Francis Group, USA), 2009, ISBN 978-1-4200-7368-3